A Preliminary Phytochemical Survey of Papua-New Guinea

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Botanical exploration of the island of New Guinea as a whole was not seriously undertaken until about 1875. Then and for some time subsequently, the flora of British New Guinea was less intensively studied than that of Dutch and German New Guinea (White, 1923: 8). It is not surprising, therefore, that, until recently, little attention was paid to the phytochemical resources of what is now known as the Territory of Papua-New Guinea. By contrast, active botanical research including chemistry and pharmacology of tropical plants was undertaken at Bogor (Buitenzorg) beginning in 1888 (Koolhaas, 1945: 207). In addition to limited timber-milling, exploitation of coconut (copra) and sugar cane (for propagation) nearly summarises European interest in the resources of the New Guinea flora.

So far, there has been no commercial development of an indigenous New Guinea plant as a pharmaceutic agent although the native peoples of the Territory, in common with those of other lands, possess hundreds of reputed remedies of plant origin. This empirical information has not been systematically recorded, although noteworthy attempts have been made by some interested missionaries and administration officials. Tropical countries, such as Africa and South America, with rich rain forest floras, have contributed several notable plant drugs to world medicine, e.g., quinine, cocaine, and curare. The failure of New Guinea (as well as Australia) to provide a similar array of useful drugs may be due to its comparatively late contact with modern technology, and to economic factors.

An Australian Phytochemical Survey, begun in the latter part of World War II, revealed many new and potentially valuable alkaloids, saponins, pigments, antibiotics, and other compounds of chemical interest (Webb, 1953). The tropical and subtropical rain forests of eastern Queensland and northern New South Wales yielded proportionately more species with alkaloids than did other plant formations. Their specific diversity, and the large quantities of bark and other material available for analysis from the dominant tree flora, make the rain forests an attractive sample reservoir for organic chemists. Many of the alkaloid-bearing families, such as Rutaceae, Lauraceae, Loganiaceae, Monimiaceae, Menispermaceae, Apocynaceae (Webb, 1952*a*), are characteristic inhabitants of the tropics, and are well represented in New Guinea.

This prompted a recommendation to the Commonwealth Scientific and Industrial Research Organization from the Third Australian Phytochemical Conference held in Sydney in May, 1951, that a brief reconnaissance of New Guinea phytochemical resources and facilities be made, to serve as a basis for a later more intensive survey, e.g., in conjunction with the Land Research and Regional Survey Section

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(C.S.I.R.O.). This recommendation was approved and the writer and Dr. C. Barnard (Division of Plant Industry, C.S.I.R.O.) spent August and September, 1951, in various parts of the Territory of Papua and New Guinea. Lowland areas near Port Moresby, Popondetta, Lae, and Rabaul, and highland areas at Wau, Aiyura, and Nondugl, were selected as representative plant communities, accessible within the brief itinerary planned. Colonel J. K. Murray, then Administrator of the Territory of Papua-New Guinea, and other administration officials were responsible for transport and accommodation arrangements.

Following the stimulus to interested people provided by this trip, and a subsequent appeal (Webb, 1952*b*), several plants reputed to be native remedies were received from New Guinea. Some of these are active pharmacologically and are being examined further. Among these are possible antibiotics and plants reputed to cause temporary sterility in women. Alkaloids in species of Rutaceae and Monimiaceae have been characterized also.

METHODS

The short time in the field was obviously inadequate for systematic collecting and testing. Nevertheless, a fairly wide coverage was obtained of species common in each area. In the field, the procedure was to identify the plant, at least to family level, and if possible to genus. Because of the hurried nature of the trip, no effort was made to collect complete herbarium specimens, although small wood samples were obtained wherever possible. Thus specific identification of relatively few specimens was sacrificed for coverage of a greater number of plants, many of which were identified with certainty at the generic level only. Together with the 300 samples actually collected for spot-testing, and plants tasted or otherwise rejected at sight in the field, over 600 different species of angiosperms were examined, chiefly for alkaloids, during the trip.

Once the botanical affinities of a plant were known, its promise as a source of alkaloids, saponins, etc., could be judged to some extent, on the basis of experience in the Australian Phytochemical Survey. Tasting of bark, seeds, etc. was freely used as a guide (although certain inimical families such as Anacardiaceae were not tested in this way). For example, bitterness in Lauraceae, particularly if a *Cryptocarya*, would suggest alkaloids. Bitterness in Rhamnaceae, on the other hand, indicates that saponins are likely to be present. With practice, alkaloids and saponins may sometimes be differentiated by taste alone. Other field criteria such as colour of inner bark were used in certain cases. Thus, vivid yellow inner bark in *Evodia*, *Acronychia* or *Melicope* (Rutaceae) supplements the evidence of bitterness that alkaloids (e.g., acridones) may be present.

If, in terms of the above criteria, the plant was considered of chemical interest, small samples of bark, wood, and leaves (and flowers or fruits if available) were collected. These samples, with the exception of wood, were preserved in envelopes (5 × 8 in.) pressed flat, in large sealed tins (2 gal. capacity) containing silica gel. In addition, confirmatory chemical tests (cf., Webb 1949, 1952*a*) were made at field headquarters of promising alkaloid plants. About 25 species were then (while in each area) collected in bulk (av. 10–20 lbs.) for detailed analysis in Australia. Air-drying and silica gel preservation were used for these samples. About 300 small samples (serving both for identification and chemical testing) were collected.

In Brisbane, samples were tested for alkaloids, using both hydrochloric acid and Prollius extracts, according to the methods outlined by Webb (1949, 1952*a*).

Plants were tested for saponins by the so-called froth test. The finely chopped material was boiled with water, cooled, and shaken. The production of a stable, characteristic "honeycomb" froth indicates the presence of saponin (cf., Dunstan, 1948).

The Liebermann-Burchard test was used to detect the presence of polycyclic substances. A small amount of dried, finely chopped material was treated, on a white spotting tile, with a few drops of acetic anhydride, then with 1–2 drops of concentrated sulphuric acid. Triterpenoids (in dicotyledons) give purple and pink colours, which are more persistent than the blue shades suggestive of steroids (chiefly in monocotyledons).

If both froth and Liebermann-Burchard tests, or froth test only, are positive, saponin is probably present. If only Liebermann-Burchard test is positive, then a free polycyclic substance may be present (Dunstan, 1948).

Samples were also tested for aluminium accumulation, using the method of Chenery (1948), and the results are published elsewhere (Webb, 1954).

In addition, other features of the plants such as presence of essential oils, foetid smell (e.g., methyl mercaptan), and pigments were noted. As specific tests were not applied, these data have been omitted.

Samples of reputed medicinal plants were collected for identification also, and this information will be published elsewhere.

For convenience, the families in Table 1 are arranged alphabetically. Brief comments, in terms of the Australian survey, are made concerning the phytochemical promise of each group. As specific identifications were not always possible, only the genus is given. Native names were noted for some of the plants and are given in Table 1 following the locality, in parentheses. The native names are in quotation marks followed by the name of the dialect. These are spelled phonetically, using the conventions of pidgin English (cf., Murphy, 1949). They are included with diffidence, but may serve, together with locality, to particularize the plants collected.

TABLE 2
SUMMARY OF SPOT-TEST RESULTS

	ALKALOID	FROTH	LB	FROTH & LB	TOTAL TESTED
Species . .	27	18	41	17	295
Genera . .	19	17	32	16	214
Families .	9	13	23	10	78

Alkaloids in 9 per cent, saponins in 12 per cent, free triterpenoids or steroids 14 per cent.

DISCUSSION

It is evident that numerous species of New Guinea flowering plants are worthy of detailed examination for alkaloids, saponins, pigments, cyanogenetic glycosides and other compounds. The present brief survey did not reveal any alkaloid-bearing families additional to those found in the Australian survey (Webb, 1953: 44). Additional genera containing alkaloids were found, however. Many positive genera have species endemic to New Guinea which should be systematically tested. The complexity of the flora requires search by, and co-operation with, experienced systematic botanists. Also, sampling of quadrats of adequate area (preferably several hectares), in which all species are differentiated, with the aid of competent natives if botanists are not available, would provide both useful phytochemical and ecological data. The relative inaccessibility of most areas of New Guinea requires special provision for on-the-spot drying of bulk samples for analysis, which should then be transported in air-tight containers. Record of authentic native name and dialect of the particular species facilitates further collections when a botanist is not in the area.

The Standing Committee of Pacific Botany, Pacific Science Association, formed a subcommittee on Medicinal Plants in 1953 (Chairman: Professor Ir. Kusnoto Setyodiwiryo). Also, the Pan Indian Ocean Scientific Congress held in Perth, West Australia, in 1954, discussed the organization of a joint drug plants survey. It is hoped that these practical efforts will result in a systematic, and long overdue, inventory of the plant products of the Indo-Malaysian region north of Australia.

TABLE 1

Summary of Spot-tests of Papua-New Guinea Plants

(alk—alkaloid; froth—saponin; LB—Liebermann-Burchard test for polycyclic compounds; neg—all tests negative)

FAMILY AND GENUS	LOCALITY	RESULTS	COMMENTS
Acanthaceae			
Graptophyllum	Sogeri	1† neg	
Amaryllidaceae			
Crinum	Malahang	1 alk	Alkaloids likely in other spp.
Anacardiaceae			
Buchanania	Popondetta ("Siruga"—Orakaiva)	1 neg	No alkaloid promise; *Semecarpus* spp. have vesicant saps
Mangifera	Malahang	1 neg	
Annonaceae			
Cananga	Yalu	1 alk (trace)	Australian members not promising but more tropical New Guinea spp. worth systematic tests, including seeds
Goniothalamus	Lae	1 neg	
Polyalthia?	Popondetta ("Koro"—Orakaiva)	1 alk (trace)	
Apocynaceae			
Alstonia	Lae, Aiyura ("Iortna"—Gasup)	2 alk, LB	All spp. have alkaloids; triterpenes worth checking
Cerbera	Lae	1 neg	Seeds have cardiac glycoside
Ervatamia	Laloki R., Eilogo, Yalu	3 alk, 1 LB	Limited Australian experience suggests alks. relatively intractable
Ichnocarpus	Bisinumu	1 neg	
Rejoua	Lae	1 alk, LB	
Voacanga	Eilogo	1 alk	
Tribe Echitidae	Yalu	1 LB	The family is worthy of examination for triterpenoids; several other alkaloidal New Guinea spp. are available, e.g., *Melodinus* and *Ochrosia*
Aquifoliaceae			
Ilex	Wau, Nondugl ("Kamlins")	1 froth, LB	This family is not well represented locally
Araliaceae			
Boerlagiodendron?	Lae		
spp.	Malahang ("Sangara"), Aiyura ("Baki"—Gasup)	1 froth, LB	A family of great saponin interest, e.g., *Polyscias*, *Schefflera*
Aristolochiaceae			
Aristolochia	Malahang, Popondetta ("Holo"—Orakaiva)	2 alk (roots)	
Asclepiadaceae			
Dischidia	Bisinumu	1 LB	Cardiac glycosides in this family
Marsdenia	Aiyura ("Zunana"—Gasup)	2 neg	

TABLE 1—(Continued)

FAMILY AND GENUS	LOCALITY	RESULTS	COMMENTS
Barringtoniaceae			
Barringtonia	Sogeri	1 froth, LB	
Bignoniaceae			
Dolichandrone	Malahang	1 neg	
Boraginaceae			
Heliotropium	Laloki R.	1 neg	Some Australian spp. contain alkaloids and are toxic
Burseraceae			
Canarium	Lae, Aiyura ("Iampeika"—Gasup)	1 LB, 2 neg	
Chloranthaceae			
Ascarina	Nondugl ("Manggyi")	1 neg	
Combretaceae			
Terminalia	Popondetta ("Kauja"—Orakaiva)	1 froth (trace)	Yellow pigments of bark and leaves worth checking
Cucurbitaceae			
Sp.	Malahang ("Kunu")	1 froth	Bitter principles also occur in this sometimes toxic family
Cunoniaceae			
Opocunonia	Aiyura ("Narngkunda" & "Vinarka"—Gasup)	1 LB, 2 neg	A well-represented family of apparently little chemical interest on present standards
Pullea	Nondugl ("Wiyak")	1 neg	
Spp.	Nondugl ("Kuma," "Yak")	2 neg	
Datiscaceae			
Octomeles	Lae	1 LB	A small family in which unusual polycyclic bodies may be expected to occur
Dilleniaceae			
Dillenia	Lae	1 LB	
Tetracera	Malahang ("Tipepei")	1 neg	
Dioscoreaceae			
Dioscorea	Lae	1 LB	Steroid sapogenins probable
Dipterocarpaceae			
Anisoptera	Popondetta (? "Garawa"—Orakaiva)	1 neg	A characteristic group of little chemical interest on present standards
Hopea	Eilogo	1 neg	
Ebenaceae			
Diospyros	Wau, Nondugl ("Bunyum")	1 LB, 1 neg	Yellow pigment of bark and fruits worth checking
Elaeocarpaceae			
Elaeocarpus	Bisinumu, Aiyura ("Yohin"—Gasup)	3 neg	
*Sp.	Lae	1 froth	
Ericaceae			
Rhododendron	Wau, Nondugl ("Umbwam")	1 LB, 1 neg	

Escalloniaceae			
Carpodetus	Nondugl ("Kwong")	1 alk?	
Quintinia	Aiyura ("Amorpandu"—Gasup)	1 LB	
*Sp.		1 froth	
Euphorbiaceae			
Antidesma	Wau, Aiyura	2 neg	A large group, certainly of negligible alkaloid interest; triterpenes and proteolytic enzymes may be expected in some latex-bearing spp.
**Aporosa*	Aiyura	1 neg	
Baccaurea	Lae	1 neg	
Breynia	Malahang, Nondugl ("Bergu")	2 neg	
Bridelia	Popondetta ("Horogo"—Orakaiva)	1 neg	
Endospermum	Yalu	1 neg	
Glochidion	Lae, Wau, Nondugl ("Kiliman")	1 froth, 1 neg	
Macaranga	Malahang, Nondugl ("Kuma")	2 neg	
Mallotus	Malahang ("Kiauya")	1 neg	
Pimeleodendron	Lae	1 LB	
Spp.	Aiyura ("Kuwan"—Gasup), Keravat, Sogeri	6 neg	
Sect. Crotonoideae	Aiyura ("Bwakei"—Gasup), Popondetta ("Korina"—Orakaiva)	1 froth, 1 neg	
Fagaceae			
Castanopsis	Eilogo	1 froth, LB	
Lithocarpus	Aiyura ("Ortna"—Gasup)	1 froth	
Nothofagus	Nondugl ("Karap")	1 froth	
Pasania	Wau, Aiyura ("Yanuna"—Gasup), Nondugl ("Nongi")	1 froth, LB, 1 neg	
Polypodiaceae			
Cyclosorus	Malahang ("Balum")	1 neg	
Flacourtiaceae			
Pangium	Yalu, Sogeri, Popondetta ("Puga"—Orakaiva)	1 neg	
*Spp.	Nondugl ("Dolbot"), Popondetta ("Bareha"—Orakaiva)	2 neg	
Gesneriaceae			
Cyrtandra	Aiyura	1 LB	
Gnetaceae			
Gnetum	Bisinumu, Lae ("Ara")	1 alk (trace) froth (trace)	
Guttiferae			
Calophyllum	Aiyura ("Wandanamu"—Gasup)	1 neg	
Garcinia	Zenag, Nondugl ("Kitan"), Popondetta ("Susumi" and "Kaimusa"—Orakaiva)	1 froth, LB 2 neg	Yellow pigment
Himantandraceae			
Galbulimima	Aiyura ("Orfum"—Gasup)	1 alk	Two other spp. are recorded, and alkaloids would be expected
Icacinaceae			
**Platea*	Aiyura ("Ukuko"—Gasup)	1 LB	
**Tylecarpus?*	Popondetta ("Siganapa"—Orakaiva)	1 neg	
Sp.	Nondugl (? "Wi")	1 neg	

TABLE 1—(Continued)

FAMILY AND GENUS	LOCALITY	RESULTS	COMMENTS
Juglandaceae			
Engelhardtia	Eilogo	1 neg	
Lauraceae			
Actinodaphne	Lae	1 alk	
Cassytha	Malahang	1 alk	
Cinnamomum	Zenag, Wau, Popondetta ("Saruka"—Orakaiva)	2 neg	
Cryptocarya	Bisinumu, Aiyura ("Berpa"—Gasup)	5 neg	Alkaloids possible in some spp.; over 30 spp. of *Cryptocarya* are recorded
Endiandra	Aiyura	1 neg	
Litsea	Lae, Aiyura ("Bwa"—Gasup), Nondugl ("Nimbyilth"), Sogeri, Popondetta ("Okumba"—Orakaiva)	1 alk? 5 neg	But triterpenes worth checking
Pseudocryptocarya	Aiyura ("Antnu"—Gasup)	1 alk	Very closely related to the vesicant alkaloid-containing *Cryptocarya pleurosperma* of North Queensland
Leguminosae			
Albizia	Bisinumu	1 froth	
Archidendron	Lae, Aiyura ("Morkaia"—Gasup)	2 neg	
Crotalaria	Nondugl	1 neg	Alkaloid likely in some spp.
Inocarpus	Lae	1 neg	
Maniltoa	Lae	1 neg	
Piptadenia	Lae	1 alk?	
Pongamia	Lae	1 froth	
Pterocarpus	Lae ("Yomisa")	1 froth	
*Spp.	Keravat, Popondetta ("Haruma"—Orakaiva)	3 neg	
Liliaceae			
Cordyline	Malahang ("Si")	1 neg	
Dracaena	Eilogo	1 froth	Possible steroidal; sapogenins
Loganiaceae			
Couthovia	Laloki R., Sogeri, Popondetta (? "Paigarumba"—Orakaiva)	1 LB, 1 neg	
Geniostoma?	Wau	1 neg	
Fagraea	Sogeri	1 LB	
Strychnos	Wau	1 alk (trace)	
Lycopodiaceae			
Lycopodium	Nondugl	1 neg	
Magnoliaceae			
Elmerrillia	Eilogo	1 alk (trace)	Alkaloid worth following up, although Australian members negative
*Malvaceae(?)			
Sp.	Nondugl ("Kop")	1 alk (trace)	

Melastomataceae			
Alstronia	Wau, Edie, Ck., Popondetta ("Ahura"—Orakaiva)	3 neg	
Sp.	Nondugl ("Yimbi")	1 neg	
Meliaceae			
Aglaia	Wau, Sogeri, Popondetta ("Harei"—Orakaiva)	3 neg	
Cedrela	Nondugl ("Ongguna")	1 froth	
Chisocheton	Lae	2 neg	
Dysoxylum	Lae, Wau, Aiyura, Popondetta ("Sera"—Orakaiva)	2 alk? 1 froth, 1 LB, 1 neg	
**Walsura?*	Aiyura	1 neg	
Spp.	Aiyura (? "Ohya"—Gasup)	1 froth, 1 neg	
Menispermaceae			
Legnephora	Wau	1 alk	Alkaloid occurs mainly in root-bark
Stephania	Yalu	1 alk	Many other spp., all probably alkaloidal, are recorded
Spp.	Sogeri, Popondetta	2 alk	
Monimiaceae			
Hedycarya	Lae	1 neg	Several other New Guinea genera worth trying for alkaloid, e.g., *Anthobembix*, *Lauterbachia*
Kibara	Nondugl ("Kopul")	1 neg	
**Matthaea?*	Wau	1 neg	
Dryadodaphne	Aiyura ("Anonya"—Gasup), Nondugl ("Korin")	1 alk	
Sp.	Wau	1 neg	
Moraceae			
Antiaris	Keravat	1 neg	
Artocarpus	Lae, Aiyura ("Koorta"—Gasup), Popondetta	1 LB, 2 neg	
Ficus	Malahang ("Anda," "Mogi"), Aiyura ("Koiya"—Gasup)	2 neg	
Myristicaceae			
Horsfieldia	Lae	1 neg	
Myristica	Lae, Nondugl ("Gabnyas")	2 neg	
Sp.	Aiyura ("Narmpararu"—Gasup), Popondetta (? "Foren"—Orakaiva)	2 neg	
Myrsinaceae			
Maesa		1 neg	Pigments of fruits worth checking
Rapanea	Lae, Wau	2 LB	
Myrtaceae			
Octomyrtus	Nondugl ("Tambanei")	1 froth (trace)	
Syzygium	Lae, Aiyura ("Monu" & "Baiyuka"—Gasup), Nondugl ("Nantz"), Popondetta	1 froth, 2 LB, 2 neg	
Ochnaceae			
Brackenridgea	Eilogo	1 froth (trace)	
Olacaceae			
Ximenia	Popondetta ("Babuso"—Orakaiva)	1 neg	Leaves and fruits cyanogenetic

TABLE 1—(Continued)

FAMILY AND GENUS	LOCALITY	RESULTS	COMMENTS
Oleaceae			
Linociera	Aiyura	1 neg, 1 alk (trace)	
Spp.	Aiyura (? "Ohbiya"—Gasup)	1 neg	
Oxalidaceae			
Oxalis	Nondugl	1 neg	
Peripterygiaceae			
Peripterygium	Malahang	1 neg	
Piperaceae			
Piper	Lae, Yalu, Wau	3 neg	
Pittosporaceae			
Pittosporum	Edie Ck., Zenag, Aiyura (? "Aratna"—Gasup), Nondugl ("Milyun"), Sogeri	3 froth, 3 LB 2 neg	
Proteaceae			
Grevillea	Nondugl ("Kwimat")	1 neg	
Helicia	Nondugl ("Kimbront," "Arilt")	3 neg	
Rhamnaceae			
Emmenosperma	Popondetta ("Saraimbu"—Orakaiva)	1 froth	
Rosaceae			
Pygeum	Lae, Nondugl ("Bulnbat")	1 LB	Bark cyanogenetic
Rubiaceae			
Anthocephalus	Yalu, Popondetta	1 alk (trace)	So far, a disappointing family for alkaloids
Gardenia	Laloki R, Zenag, Nondugl ("Bulus")	1 froth, 3 LB	
Ixora	Lae	1 neg	
Mastixiodendron	Aiyura	1 alk?	
Morinda	Malahang ("Toon")	1 neg	
Mussaenda	Bisinumu, Yalu	2 neg	
Neonauclea	Lae	1 neg	
Opercularia?	Aiyura ("Malonka"—Gasup)	1 neg	Foetid, probably methyl mercaptan
Pavetta	Laloki R	1 alk (trace)	
Paederia	Rabaul	1 neg	Foetid, probably methyl mercaptan
Randia	Lae, Aiyura ("Opu"—Gasup), Popondetta ("Hara"—Orakaiva)	1 alk, 2 neg	Alkaloid may be unstable
Tarenna	Eilogo	1 LB	
Timonius	Zenag	1 LB	
Uncaria	Eilogo	1 alk (trace)	
Wendlandia	Wau	1 neg	
Spp.	Lae, Aiyura ("Sinakario"—Gasup), Nondugl ("Misik" & "Topnam"), Popondetta	1 alk? 1 froth 1 LB, 4 neg	

Rutaceae			
Acronychia	Aiyura, Garoka, Aiyura ("Durp")	4 neg	Numerous other New Guinea spp. worth trying for alkaloids; about 18 *Acronychia*, 57 *Evodia*, and 23 *Melicope* spp. are recorded
Evodia	Bisinumu, Eilogo, Lae, Zenag, Wau, Edie Crk., Aiyura ("Ohday"—Gasup), Popondetta	2 alk, 7 neg	
Flindersia	Wau	1 neg	
Glycosmis	Laloki R	1 alk	
Halfordia	Aiyura	1 alk	
Melicope	Wau, Nondugl ("Liling")	2 neg	
Zanthoxylum	Aiyura ("Amuka"—Gasup)	1 neg	
Sapindaceae			
Allophylus	Lae	2 neg	A family of obvious saponin interest
Arytera	Sogeri	1 froth	
Ganophyllum	Lae	1 froth	
Pometia	Yalu, Popondetta ("Hoijanu"—Orakaiva)	1 froth, LB	
Tristiropsis	Lae	1 froth, LB	
Spp.	Lae, Aiyura, Nondugl ("Yimyih"), Popondetta ("Umbupu"—Orakaiva)	2 froth, LB, 3 neg	
Sapotaceae			
**Chrysophyllum*	Popondetta ("Djirihu"—Orakaiva)	1 neg	Latex of these spp. may be attractive to triterpene chemists
Palaquium	Lae	1 neg	
Planchonella	Lae, Aiyura ("Iapa"—Gasup), Popondetta ("Tiga" and "Jipapa"—Orakaiva)	2 LB, 2 neg	
Saurauiaceae			
Saurauia	Lae, Aiyura ("Kasu"—Gasup)	1 neg	
Simaroubaceae			
Ailanthus?	Popondetta ("Jandopupa"—Orakaiva)	1 neg	
Picrasma	Popondetta ("Haisipa"—Orakaiva)	1 alk?	Bark very bitter
Sterculiaceae			
Commersonia	Lae	1 neg	
Pterocymbium	Yalu	1 neg	
Symplocaceae			
Symplocos?	Nondugl ("Minyam")	1 froth, LB	
Theaceae			
Gordonia	Nondugl ("Kauragu" and "Kapakup")	1 froth, LB	
Ternstroemia	Popondetta ("Sisingi"—Orakaiva)	1 froth, LB	
*Sp.	Nondugl (? "Gaindu")	1 neg	
Thymelaeaceae			
Phaleria	Lae	1 neg	
Trimeniaceae			
Trimenia	Edie Ck.	1 neg	Bark very bitter
Urticaceae			
Laportea	Yalu	1 neg	Has irritant stinging hairs
Leucosyke	Lae	1 neg	
Sp.	Malahang ("Kavisa," "Salat")	1 neg	

TABLE 1—(Continued)

FAMILY AND GENUS	LOCALITY	RESULTS	COMMENTS
Vacciniaceae			
Agapetes	Wau	1 LB	
Vaccinium	Wau	1 LB, froth (trace)	
*Spp.	Nondugl ("Kapikap")	1 LB	
Verbenaceae			
Callicarpa	Lae, Zenag	1 neg, 1 LB	
Gmelina	Aiyura ("Kauia"—Gasup)	1 froth	
Vitex	Popondetta ("Sisaru"—Orakaiva)	1 LB	
Family Unplaced			
Spp.		2 LB, 2 neg	
Families not tested, but of interest:			
Erythroxylaceae	Alkaloids probably present in bark and leaves of *Erythroxylon* spp.		
Hernandiaceae	*Hernandia papuana* bark probably alkaloidal		

*Determinations based on wood only.
† Numerals refer to the number of species tested.

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